

Visual Aids to Navigation

Dispelling aid availability myths.

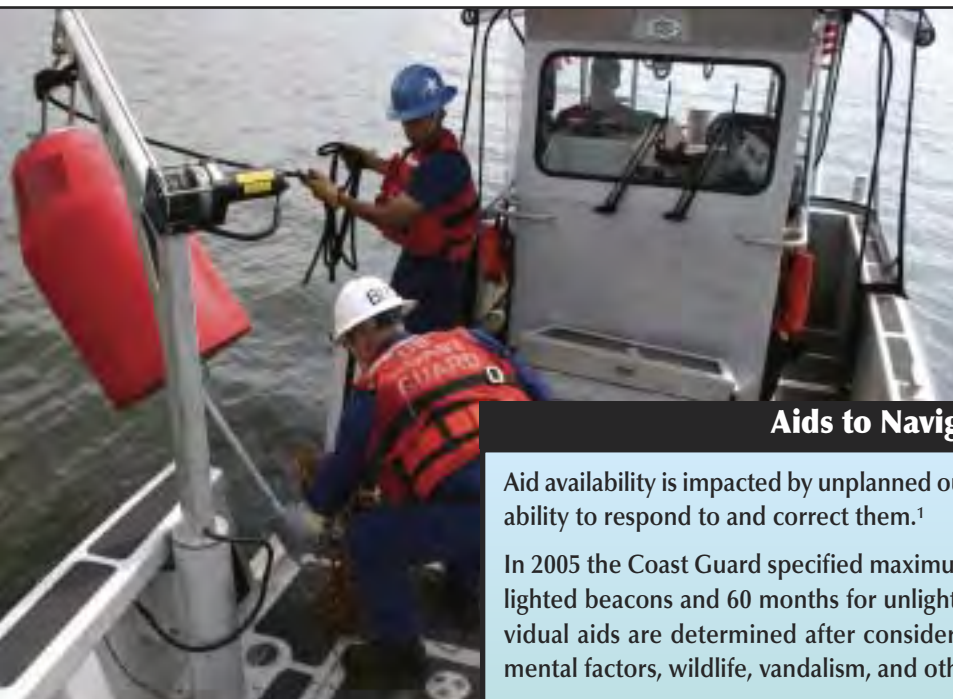
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Aid availability¹ for the United States visual aids to navigation system is calculated monthly by the U.S. Coast Guard Marine Transportation Systems Management Directorate's Visual Aids to Navigation Division. These calculations can be presented by criticality category and broken down to various responsibility and servicing levels, including district, sector, servicing unit, waterway, and individual aid to navigation.

Frequent updates and convenient data presentation lead many waterways managers to assume that aid availability provides a comprehensive assessment of the health and effectiveness of aids to navigation (ATON) in their waterways as well as the efficiency of their ATON service delivery units. This mistaken assumption has perpetuated the following aid availability myths:

- Aid availability is proportional to recurring ATON funding levels.
- Aid availability provides an accurate assessment of an ATON service delivery unit's efficiency.
- Unscheduled maintenance of ATON service delivery platforms (cutters and boats) or emergency diversion to other mission areas directly impacts aid availability.
- Aid availability is primarily impacted by ATON component reliability.



An aids to navigation team services a small foam buoy. All photos USCG.

Aids to Navigation Discrepancies

Aid availability is impacted by unplanned outages, or ATON discrepancies, and the Coast Guard's ability to respond to and correct them.¹

In 2005 the Coast Guard specified maximum maintenance intervals of 36 months for buoys and lighted beacons and 60 months for unlighted beacons. Specific maintenance intervals for individual aids are determined after considering component reliability and service life, environmental factors, wildlife, vandalism, and other factors.

The USCG uses a discrepancy response factor—a numerical indicator measuring the criticality of the discrepant ATON—to prioritize response. The higher the number, the more critical the aid is to safe navigation, and hence the higher the priority for response and correction.

Endnote:

¹ An ATON discrepancy occurs when an aid is unable to perform its intended function or exhibit its advertised characteristics. The visual aids to navigation system suffers an average of 10,200 discrepancies annually, which encompasses nearly 29 percent of the total ATON population.

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Dispelling the Myths

Myth—Aid availability is proportional to recurring ATON funding levels. This is predicated on the assumption that recurring funding levels could be reduced if aid availability goals were lowered. Since the purpose of the visual aids to navigation system is to mitigate marine transportation system transit risks, it doesn't seem prudent to manage funding levels by manipulating aid availability goals. The efficiency by which the USCG corrects ATON discrepancies directly impacts aid availability, so lowering aid availability goals would suggest that the Coast Guard should reduce its efficiency.

Furthermore, being less proficient at periodic maintenance or ATON discrepancy response would likely result in a much greater expense when the discrepancy is eventually corrected. For example, costs associated with lighted buoy inspection and maintenance typically include:

- operating expenses and personnel costs for the primary service delivery unit,
- procurement costs for replacing sections of the buoy's mooring system and other equipment required for the buoy.

If, in a cost savings measure, the maintenance isn't performed as scheduled, the buoy's mooring chain could break, leaving the buoy adrift. The resulting additional costs include:

- recovering the buoy,
- replacing the buoy and its entire mooring system and outfit (lantern, power system, etc.).

In addition, timely response and correction of an ATON discrepancy could help prevent a much costlier incident, such as a vessel collision or grounding.

The annual recurring funding for establishing, maintaining, and operating the U.S. visual aids to navigation system is approximately \$300 million. Ninety percent of that goes towards personnel, ATON servicing platform operations and maintenance, and indirect support costs.

The remaining \$30 million finances everything that either produces or supports an ATON signal (repair, maintenance, and replacement costs of buoys; buoy mooring systems; beacon structure components; optics; power systems; and day signals).

This funding level has been static over the past 10 years, with slight adjustments for consumer price index considerations. During that period, aid availability fluctuated by as much as 1.28% in one year. In the years of low aid availability (2005 and 2006), the ATON mission was allocated supplemental funding to reconstitute the visual aids to navigation system in those waterways disrupted by a series of major hurricanes.

Calculating Aid Availability

Aid availability is calculated by subtracting the length of time that an aid is unable to perform its specified function (down time) from the length of time that it should be performing its specified function (total time), divided by the total time.

This can be used to measure an individual aid or a system of aids to navigation.

Aid Availability =

$$\frac{(\text{Total Time} - \text{Down Time})}{\text{Total Time}} \quad \text{or} \quad \frac{\text{Up Time}}{\text{Total Time}} \quad \text{or} \quad \frac{\text{MTBF}}{(\text{MTBF} + \text{MTTR})}$$

MTBF = Mean Time Between Failure

MTTR = Mean Time to Repair

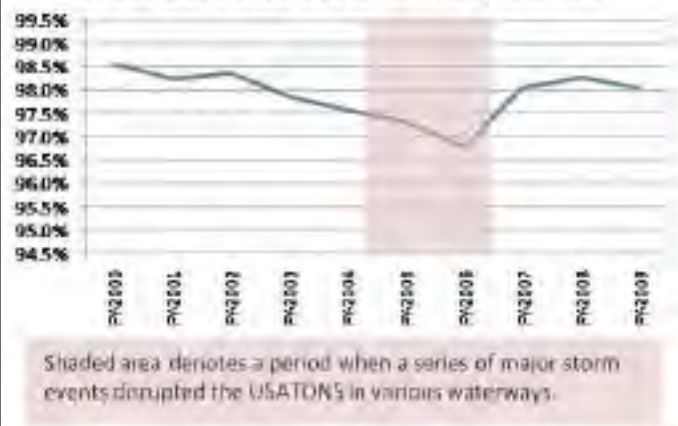
Myth—Aid availability provides an accurate assessment of an ATON service delivery unit's efficiency. This myth equates a falling or raising aid availability with the efficiency of an ATON service delivery unit. While a service delivery unit's efficiency could certainly impact aid availability, there are a variety of other factors that could have a greater influence. Consider the following scenarios:

Scenario 1 – A vessel runs over a single-pile wooden lighted beacon, severing the pile below the seabed. The responding aids to navigation team deploys to investigate and determines that restoring it to its intended purpose requires a marine construction pile-driving effort. The team then searches the area for wreckage and deploys a temporary lighted buoy on the missing lighted beacon's assigned position.

The result: The aids to navigation team has performed its mission per USCG policy, but has not reduced the discrepancy's impact on aid availability.

Scenario 2 – A storm has buffeted a coastal area for several days. On the first day of the storm, ATON service-

USATONS Aid Availability Rates





A temporary lighted buoy marks the wreckage of a lighted beacon, which was damaged after a vessel collision.



A collapsed lighted beacon in Semiahoo Bay, Wash.

ing units were notified of several “priority” discrepancies.² However, the sea conditions preclude the aids to navigation team from deploying to investigate. Therefore, it may be several days after receiving the report before the team is able to respond. Aid availability suffers, but it is not caused by the ATON service delivery unit’s inefficiency.

Myth—Unscheduled maintenance of ATON service delivery platforms or emergency diversion to other mission areas impacts aid availability. The USCG’s ATON multi-tiered maintenance strategy provides reserve capacity, including primary and secondary service delivery units, for these and other contingencies.

During the *Deepwater Horizon* response, the USCG deployed half the seagoing buoy tender fleet and a quarter of the coastal buoy tender fleet to assist with oil cleanup efforts. As of October 2010, the majority of these assets had been deployed in support of this effort for over four months. During that time, short-term aid availability remained nearly constant at 98.52 percent.³

Short-term absences, such as unscheduled maintenance, seem to be adequately absorbed by multi-tiered maintenance strategy, with two exceptions:

- When short-term absences of ATON service delivery platforms correspond with a major waterway disruption, such as a major weather event, where a considerable surge operation is necessary to reconstitute the aids in the affected waterways.
- When the unscheduled maintenance of certain specialized ATON service delivery platforms results in the loss of that capability for an extended period. For example, inland construction tenders in the 5th, 7th, and 8th USCG districts repair or rebuild an average of 2,450 beacons annually, which is beyond the capability of other service delivery platforms.

Myth—Aid availability is primarily impacted by ATON component reliability. This assumes that an increase in ATON component failures (power systems,

Aid Availability History

The concept of aid availability became a topic of international interest in the mid-1970s when significant numbers of light-houses were being automated. The Coast Guard implemented aid availability as a performance measure in the 1990s and established an overall strategic aid availability goal of 99.7 percent.

Since waterways have a variety of traffic patterns and risk levels, the Coast Guard assigned each of its aids to navigation to one of three categories based on the critical nature of the aid, the type and volume of marine traffic, the waterway configuration, and environmental considerations.

- Category 1: Vital navigational significance – aid availability goal = 99.8 percent.
- Category 2: Important navigational significance – aid

availability goal = 99 percent.

- Category 3: Necessary navigational significance – aid availability goal = 97 percent.

Certain anomalies, such as major weather events, can have a short-term negative impact on aid availability. The International Association of Marine Aids to Navigation and Light-house Authorities (IALA) recommends tracking aid availability for three continuous years to accurately determine trends.

IALA also recommends that the minimum aid availability for any aid should not fall below 95 percent and that consideration should be given to discontinuing or replacing aids to navigation that consistently fall below that threshold.¹

¹ IALA Recommendation O-130, Edition 1, Dec. 2004.

Fiscal Year	Percent of Discrepancies Caused by Component Failure	Annual Aid Availability Rate
2001	50%	98%
2006	17%	96.8%

The percentage of discrepancies attributed to component failure reached a 10-year high at 50 percent in 2001, but the annual aid availability that year was higher than the 10-year average at 98.3 percent. Conversely, when the annual aid availability fell to 96.8 percent in 2006 (the lowest 10-year level), component failures only accounted for 17 percent of all discrepancies.



USCG *Sledge* crew recovers wreckage and rebuilds an aid. USCG photo by Mr. Robert Trainor.

optics, buoys, mooring chain, dayboards, etc.) has a direct impact on the aid availability rate. However, an analysis of discrepancy data over the past 10 years does not support this assumption.

While component failures certainly influence discrepancy rates and may influence aid availability, the data does not support a direct correlation (see above example).

The Continuing Mission

To appropriately focus their resources, waterway managers must carefully measure the state of the aids to navigation systems under their purview. Aid availability rate is just one of the tools they use.

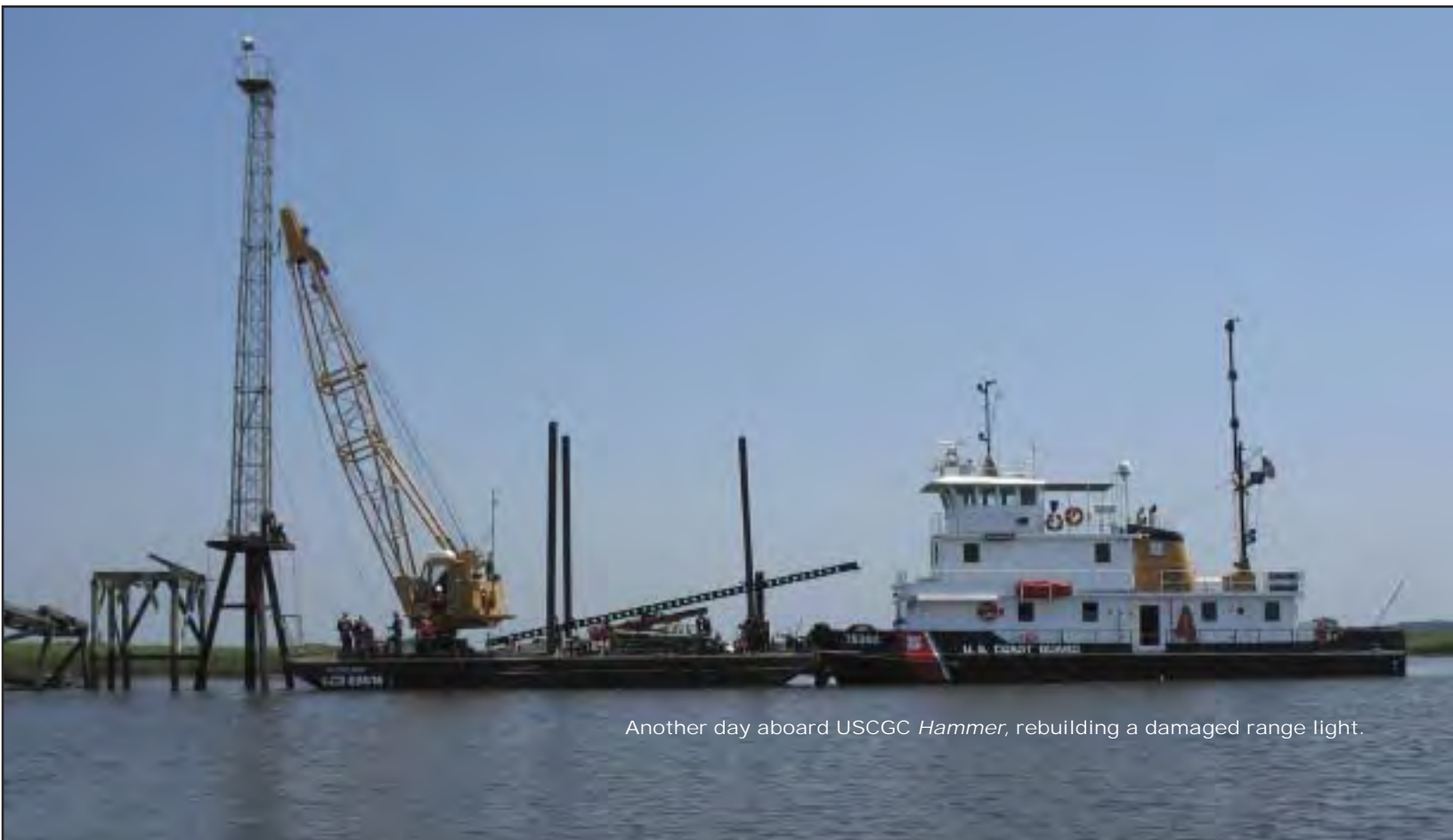
We must be mindful, however, to consider this information in perspective and in conjunction with other metrics to accurately assess overall waterway ATON health and effectiveness.

About the author:

Mr. Robert Trainor is an aids to navigation specialist in the Marine Transportation Systems Management Directorate, Visual Navigation Division at U.S. Coast Guard headquarters. He previously spent more than 30 years on active duty military service in the USCG, and his duty assignments included tours as commanding officer of two buoy tenders as well as numerous other aids to navigation positions.

Endnotes:

- ¹ Aid availability is defined in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Aids to Navigation Manual as "... the probability that an aid to navigation or system is performing its specified function at any randomly chosen time."
- ² One of five USCG ATON discrepancy response levels.
- ³ Four-month average: June through September 2010.



Another day aboard USCGC *Hammer*, rebuilding a damaged range light.